

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property **Organization** International Bureau





(43) International Publication Date 1 April 2004 (01.04.2004)

PCT

(10) International Publication Number WO 2004/027369 A3

(51) International Patent Classification⁷:

G01M 3/04

(21) International Application Number:

PCT/CA2003/001434

(22) International Filing Date:

19 September 2003 (19.09.2003)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

60/411,786

19 September 2002 (19.09.2002)

- (71) Applicant (for all designated States except US): NA-TIONAL RESEARCH COUNCIL OF CANADA [CA/CA]; 1200 Montreal Road, Building M-58, Room EG-12, Ottawa, Ontario K1A 0R6 (CA).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): HU. Cheng [CN/CA]; 5115 Chambers Street, Vancouver, British Columbia V5R 3L8 (CA). QU, Xidong [CN/CA]; 1102 - 9521 Cardston Court, Burnaby, British Columbia V3N 4R8 (CA). WU, Jonathan, Q., M. [CA/CA]; 8191 Hudson Street, Vancouver, British Columbia V6P 4M2 (CA). STANLEY, Kevin, G. [CA/CA]; 2343 Trafalgar Street, Vancouver, British Columbia V6K 3T1 (CA).

- (74) Agents: BAILEY, Thomas, W. et al.; Oyen Wiggs Green & Mutala, 480 - The Station, 601 West Cordova Street, Vancouver, British Columbia V6B 1G1 (CA).
- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR. TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

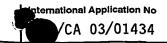
- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of
- (88) Date of publication of the international search report: 18 November 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND APPARATUS FOR DETECTING AND LOCATING GAS LEAKS

(57) Abstract: The invention provides an apparatus and method for detecting the location of a gas leak within a test region. The invention comprises an array of calibrated sensors for measuring a plurality of gas concentrations, a control system coupled to the sensor array for calculating and optionally displaying a direction of higher gas concentration, and, an actuator for moving the sensor array under control of the control system, wherein the control system causes the array of sensors to measure the gas concentrations and move in the direction of higher concentration until a stopping condition is achieved. The stopping condition may be achieved when the measured gas concentration exceeds a predetermined threshold or when the concentration otherwise likely corresponds to the leak location based on a comparison with previously measured values.

INTERNATIONAL SEARCH REPORT



A. CLASSIFICATION OF SUBJECTMATTER IPC 7 G01M3/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols) IPC 7 G01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

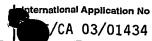
EPO-Internal, PAJ, WPI Data

| C. DOCUM | ENTS CONSIDERED TO BE RELEVANT | | |
|------------|--|-----------------------|--|
| Category ° | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. | |
| X,P | WO 03/012387 A (LATTICE INTELLECTUAL PROPERTY; PRIDE RUSSELL DESMOND (GB)) 13 February 2003 (2003-02-13) page 1 - page 6 | 1-10, 16-20 | |
| Y | US 5 301 538 A (RECLA DENNIS) 12 April 1994 (1994–04–12) claims 1–11 | 1-10,16 | |
| Υ . | US 6 157 033 A (CHUDNOVSKY BELLA HELMER) 5 December 2000 (2000-12-05) column 3 - column 6 | 1-10, 16-20 | |
| Υ | US 5 214 412 A (GAVLAK MICHAEL A ET AL) 25 May 1993 (1993-05-25) column 2 - column 4 | 17–20 | |
| | -/ | | |
| | | | |
| | | | |

| Further documents are listed in the continuation of box C. | χ Patent family members are listed in annex. | | | | |
|--|---|--|--|--|--|
| Special categories of cited documents: A' document defining the general state of the art which is not considered to be of particular relevance E' earlier document but published on or after the international filling date L' document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) O' document referring to an oral disclosure, use, exhibition or other means P' document published prior to the international filling date but later than the priority date claimed | "T" later document published after the International filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family | | | | |
| Date of the actual completion of the international search 29 September 2004 | Date of mailing of the international search report $06/10/2004$ | | | | |
| Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo ni, Fax: (+31-70) 340-3016 | Authorized officer Dietrich, A | | | | |

3

INTERNATIONAL SEARCH REPORT



| 0./0 | ation) DOCUMENTS SIDERED TO BE RELEVANT | /CA 03/01434 | | |
|------------|--|-----------------------|--|--|
| Category ° | | | | |
| Category | oration of document, with indication, where appropriate, or the relevant passages | Relevant to claim No. | | |
| Α | US 3 925 666 A (ALLAN COLIN J ET AL) 9 December 1975 (1975-12-09) column 2 - column 4 | 17-25 | | |
| Α | WO 98/46376 A (SCIENCE & ENGINEERING ASSOCIAT) 22 October 1998 (1998-10-22) claims 1-24 | 1-10 | | |
| Α . | US 6 422 061 B1 (BOEHR CHRISTOPHER K ET AL) 23 July 2002 (2002-07-23) figures 13A-G,14A-C,19,20 | 1–10 | | |
| A | PATENT ABSTRACTS OF JAPAN vol. 1996, no. 04, 30 April 1996 (1996-04-30) & JP 07 333097 A (CHIYODA CORP), 22 December 1995 (1995-12-22) abstract | 1,16,17 | | |
| A | PATENT ABSTRACTS OF JAPAN vol. 0176, no. 19 (P-1644), 15 November 1993 (1993-11-15) & JP 05 196534 A (OSAKA GAS CO LTD), 6 August 1993 (1993-08-06) abstract | 1,16,17 | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | • | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

INTERNATIONAL SEARCH REPORT

oternational Application No CA 03/01434

| | ocument arch report | | Publication date | | Patent family member(s) | | Publication date |
|---------|------------------------|----------------|------------------|----------|----------------------------|-------------|--|
| WO 030 | 12387 | Α | 13-02-2003 | EP | 1415136 | A2 | 06-05-2004 |
| | | | | WO | 03012387 | | 13-02-2003 |
| | | | | GB | 2382656 | | 04-06-2003 |
| US 530 | 1538 | A | 12-04-1994 | NONE | | | <u></u> |
| US 615 | 7033 | Α | 05-12-2000 | NONE | | | |
| US 521 | 4412 | A | 25-05-1993 | NONE | | | -, -, -, -, -, -, -, -, -, -, -, -, -, - |
| US 392 | 5666 | Α | 09-12-1975 | CA | 1007325 | A1 | 22-03-1977 |
| | | | | CA | 987927 | A2 | 27-04-1976 |
| | | | | CH | 592934 | | 15-11-1977 |
| | | | | DE | 2452685 | | 02-10-1975 |
| | | | | FR | 2250990 | | 06-06-1975 |
| | | | | GB | 1475910 | | 10-06-1977 |
| | | | | GB | 1475909 | | 10-06-1977 |
| | | | | ĪT | 1024818 | | 20-07-1978 |
| | | | | SE | 7414236 | | 15-05-1975 |
| WO 984 | 6376 | A | 22-10-1998 | AU | 7125998 | | 11-11-1998 |
| | | - - | | WO | 9846376 | | 22-10-1998 |
| US 642 | 2061 | B1 | 23-07-2002 | US | 6085576 | A | 11-07-2000 |
| | | | | ÄÜ | 5621200 | | 09-01-2001 |
| | | | | CA | 2375516 | | 28-12-2000 |
| | | | | EP | 1194762 | | 10-04-2002 |
| | | | | JP | 2003502661 | T | 21-01-2003 |
| | | | | WO | 0079243 | | 28-12-2000 |
| | | | | US | 2002178789 | | 05-12-2002 |
| | | | | AU | 756085 | | 02-01-2003 |
| | | | | AU | 3105099 | | 11-10-1999 |
| | | | | AU | 4970600 | | 21-09-2000 |
| | | | | CA | 2325137 | | 23-09-1999 |
| | | | | CN | 1301342 | | 27-06-2001 |
| | | | | EP | 1171823 | | 16-01-2002 |
| | | | | ĒΡ | 1064530 | | 03-01-2001 |
| | | | | ĴΡ | 2003526768 | | 09-09-2003 |
| | | | | JP | 2003520708 | | 12-11-2002 |
| | | | _ | NZ | 507177 | | 26-09-2003 |
| | | | • | WO | 0052444 | | 08-09-2000 |
| | | | | WO | 9947905 | | 23-09-1999 |
| | | | | US | 2002124631 | | 12-09-2002 |
| | | | | US | 6234006 | | 22-05-2001 |
| | | | | US | 2004069046 | | 15-04-2004 |
| | | | | US | 2001039824 | | |
| | | | | US | 2001039824 | | 15-11-2001 |
| | | | | AU | 1655101 | | 19-07-2001 |
| | | | | CA | 2389708 | | 14-05-2001 |
| | | | | | | | 10-05-2001 |
| | | | | EP | 1264251 | | 11-12-2002 |
| | | | | WO | 0133212 | | 10-05-2001 |
| | | | | US US | 2003216869 6606566 | | 20-11-2003 12-08-2003 |
| .1P 073 | ` 33097 | | 22-12-1995 | NONE | | | |
| 01 0/3 | | | | | | | |